

Crime Busters B - ANSWER KEY



USC Invitational
January 18, 2025

SECTION I: QUALITATIVE ANALYSIS (50% OF SCORE)

FULL POINTS for either of the slashed answers:

Unknown A (2 points):	Sodium Acetate/C ₂ H ₃ NaO ₂	* Unknown I (2 points):	Table Salt/NaCl
Unknown B (2 points):	Vitamin C/Ascorbic Acid/C ₆ H ₈ O ₆	(2 points):	Gelatin
Unknown C (2 points):	Yeast	* Unknown J (2 points):	Alka-Seltzer
Unknown D (2 points):	Baking Soda/Sodium Hydrogen Carbonate/Sodium bicarbonate/NaHCO ₃	(2 points):	Flour
Unknown E (2 points):	Cornstarch	Unknown K (2 points):	Vinegar
Unknown F (2 points):	Sugar/Sucrose/C ₁₂ H ₂₂ O ₁₁	Unknown L (2 points):	Hydrogen Peroxide/H ₂ O ₂
* Unknown G (2 points):	Sugar/Sucrose/C ₁₂ H ₂₂ O ₁₁	Unknown M (2 points):	Lemon Juice
(2 points):	Baking Soda/Sodium Hydrogen Carbonate/Sodium bicarbonate/NaHCO ₃	Unknown N (2 points):	Water/H ₂ O
* Unknown H (2 points):	Calcium Sulfate (Dihydrate)/Gypsum/CaSO ₄	Unknown O (2 points):	Copper/Cu
(2 points):	Calcium Carbonate/CaCO ₃	Unknown P (2 points):	Zinc/Zn
		Unknown Q (2 points):	Aluminum/Al

Each question in this section is ALL OR NOTHING. Chemical names corresponding with the unknown letter are acceptable.

- Of the chemicals found at the crime scene, which unknowns may react with iodine? **B, E, J +1 point**
- What side product is formed when hydrochloric acid is added to a carbonate? **CO₂ (gas) +1 point**
- How many protons does Unknown O contain? **29 +1 point**
- Which of the chemicals found at the crime scene may be used as a deicer? **Unknown I (Salt) +1 point**
- True/**False**: Unknown E is soluble in water. **+1 point**
- True/**False**: Unknown K has a neutral pH. **+1 point**
- True**/False: Unknown D is an ionic compound. **+1 point**
- True/**False**: One of the two compounds in Unknown H is crystalline. **+1 point**

SECTION II: POLYMER ANALYSIS (10% OF SCORE)

a. HAIRS: (___/12)

Identify the following hairs, and give a possible

Hair 1 (2 points):	Human	Hair 1 implicates? (2 points)	Everyone
Hair 2 (2 points):	Cat	Hair 2 implicates? (2 points)	Chloe Bourgeois
Hair 3 (2 points):	Human	Hair 3 implicates? (2 points)	Everyone

b. FIBERS: (___/12)

The rules state that students only have to identify whether the fiber is plant/animal/synthetic, but some students may be used to identifying the type of fiber. Full points for either answer.

Fiber 1 (2 points):	Cotton/Plant	Fiber 1 implicates? (2 points)	Gabriel Agreste OR Gabriel Agreste & Felix Fathom
Fiber 2 (2 points):	Wool/Animal	Fiber 2 implicates? (2 points)	Chloe Bourgeois
Fiber 3 (2 points):	Spandex/Polyester /Synthetic	Fiber 3 implicates? (2 points)	Kagami Tsurugi

c. PLASTICS: (___/12)

Identify the following plastics.

Plastic 1 (4 points):	PVC/polyvinylchloride	Plastic 3 (4 points):	LDPE/low-density polyethylene
Plastic 2 (4 points):	HDPE/high-density polyethylene		

SECTION III: CHROMATOGRAPHY (5% OF SCORE)

___/20

Attach your chromatogram in the box below. Clearly label your *team number* and *solvent front*. (10 points)

+8 points for chromatogram, +2 points for labeling solvent front **[TOTAL 10 POINTS]**

Identify the mobile phase. (2 points) Water (+2 points)

Identify the stationary phase. (2 points) Paper (+2 points)

Calculate the R_f value (4 points): 0.90 (+2 if they attempted to do division, +2 if their answer is between 0.8-1.0).

Who does this implicate? (2 points) Gabriel (+2 points)

SECTION IV: CRIME SCENE PHYSICAL EVIDENCE (10% OF SCORE)

a. FINGERPRINTS: (____/5)

Below are a set of fingerprints found at the crime scene:



FINGERPRINT #1



FINGERPRINT #2



FINGERPRINT #3



FINGERPRINT #4



FINGERPRINT #5

FULL POINTS IF THEY HAVE THE WORD BELOW IN THEIR ANSWER

Fingerprint 1 (1 point):

Loop

Fingerprint 4 (1 point)

Loop

Fingerprint 2 (1 point):

Whorl

Fingerprint 5 (1 point)

Arch

Fingerprint 3 (1 point):

Whorl

b. BLOOD SPATTERS: (____/5)



1. CIRCLE ONE: This blood spatter traveled at a _____ velocity (2 points)

a. **LOW**

b. MEDIUM

c. HIGH

2. What angle did the spatter come in contact with the surface? (It's okay to estimate!)

Any number between 40 and 60 degrees (3 points)

SECTION V: ANALYSIS (25% OF SCORE)

In the box below, **explain who you believe stole the Sapphire Solstice**. You can use bullet points or an essay format. When crafting your response, be conscious of the following questions:

- What's your evidence? Specify which unknowns.
- What's the culprit's motive?
- What rules out other suspects? What makes the evidence you found for the culprit more incriminating?

LEAVE FOR EVENT SUPERVISOR TO ANSWER

Culprit: **Chloe Bourgeois [+6 points]**

Motive: **Something reasonable [+4 points/1 point]**

Evidence: 3 points/1 point

- Salt - I
- Vinegar - K
- Hydrogen Peroxide - L
- Lemon Juice - M
- Cat - Hair 2
- Blood Spatter
- LDPE - Plastic 3
- Wool - Fiber 2
- Fingerprints - ONLY ARCH

Other Culprit:

Gabriel **[+6 points]** Evidence:

Motive: **Something reasonable [+4 points/1 point]**

Evidence: 3 points/1 point

- Vitamin C - B
- Calcium Carbonate - H
- Cotton - Fiber 1
- Aluminum - Q 3 points
- Copper - O
- Calcium Sulfate - H
- PVC - Plastic 1
- Pen 3 points
- Fingerprints - Whorl, Loop

Felix Evidence: **[1 point each]**

- Yeast - C
 - Baking soda - D&G
 - Cornstarch - E
 - Flour - J
 - Water - N
 - HDPE - Plastic 2
 - Fingerprints: Tented Arch, Whorl
- RULE OUT - [1 POINT]

Kagami Evidence: **[1 point each]**

- Sugar - F&G
 - Zinc - P
 - Gelatin - I
 - Sodium acetate - A
 - Spandex - Fiber 3
 - Fingerprint - Whorl, Loop
 - Alka Seltzer - J
- RULE OUT - [1 POINT]

The higher point designation was assigned to the culprit the team provided the most evidence for. The lower point designation was assigned to the culprit with less evidence. Ex: (if a team gives 9 pieces of evidence for Chloe, and 6 for Gabriel, the higher point designation would be given to Chloe).

Since the wording of the question implies only one culprit, the grading was changed to accept one culprit as a possible answer.

If Chloe was stated as the culprit:

Culprit: **Chloe Bourgeois [+12 points]**

Motive: **Something reasonable [+4 points]**

Evidence: **[3 points each]**

- Salt - I
- Vinegar - K
- Hydrogen Peroxide - L
- Lemon Juice - M
- Cat - Hair 2
- Blood Spatter
- LDPE - Plastic 3
- Wool - Fiber 2
- Fingerprints - ONLY ARCH

Other Suspects:

Gabriel Evidence: **[1 point each]**

- Vitamin C - B
- Calcium Carbonate - H
- Cotton - Fiber 1
- Aluminum - Q +3
- Copper - O
- Calcium Sulfate - H
- PVC - Plastic 1
- Pen +3
- Fingerprints - Whorl, Loop
- RULE OUT - [1 POINT]

Felix Evidence: **[1 point each]**

- Yeast - C
- Baking soda - D&G
- Cornstarch - E
- Flour - J
- Water - N
- HDPE - Plastic 2
- Fingerprints: Tented Arch, Whorl
- RULE OUT - [1 POINT]

Kagami Evidence: **[1 point each]**

- Sugar - F&G
- Zinc - P
- Gelatin - I
- Sodium acetate - A
- Spandex - Fiber 3
- Fingerprint - Whorl, Loop
- Alka Seltzer - J
- RULE OUT - [1 POINT]

If Gabriel was stated as the culprit:

Evidence: **[1 point each]**

- Salt - I
- Vinegar - K
- Hydrogen Peroxide - L
- Lemon Juice - M
- Cat - Hair 2
- Blood Spatter +3 potentially incriminating
- LDPE - Plastic 3
- Wool - Fiber 2
- Fingerprints - ONLY ARCH +3
- Rule out - 1 point

Gabriel **[+12]**

Motive: **Something reasonable [+4 points]**

Evidence: **[3 points each]**

- Vitamin C - B
- Calcium Carbonate - H

Felix Evidence: **[1 point each]**

- Yeast - C
- Baking soda - D&G
- Cornstarch - E
- Flour - J
- Water - N
- HDPE - Plastic 2
- Fingerprints: Tented Arch, Whorl
- RULE OUT - [1 POINT]

Kagami Evidence: **[1 point each]**

- Sugar - F&G
- Zinc - P
- Gelatin - I

- Cotton - Fiber 1
- Aluminum - Q
- Copper - O
- Calcium Sulfate - H
- PVC - Plastic 1
- Pen
- Fingerprints - Whorl, Loop

- Sodium acetate - A
- Spandex - Fiber 3
- Fingerprint - Whorl, Loop
- Alka Seltzer - J
- RULE OUT - [1 POINT]

If Felix was stated as the culprit:

Felix **[0 points: incorrect suspect]**

Motive: **Something reasonable [+4 points]**

Evidence: **[2 points each]**

- Yeast - C
- Baking soda - D&G
- Cornstarch - E
- Flour - J
- Water - N
- HDPE - Plastic 2
- Fingerprints: Tented Arch, Whorl

Kagami Evidence: **[1 point each]**

- Sugar - F&G
- Zinc - P
- Gelatin - I
- Sodium acetate - A
- Spandex - Fiber 3
- Fingerprint - Whorl, Loop
- Alka Seltzer - J
- RULE OUT - [1 POINT]

Chloe evidence

Evidence: **[1 point each]**

- Salt - I
- Vinegar - K
- Hydrogen Peroxide - L
- Lemon Juice - M
- Cat - Hair 2
- Blood Spatter
- LDPE - Plastic 3
- Wool - Fiber 2
- Fingerprints
- Rule out - 1 point

Gabriel evidence

Evidence: **[1 point each]**

- Vitamin C - B
- Calcium Carbonate - H
- Cotton - Fiber 1
- Aluminum - Q
- Copper - O
- Calcium Sulfate - H
- PVC - Plastic 1
- Pen
- Fingerprints - Whorl, Loop
- Rule out - 1 point

If Kagami was stated as the culprit:

Kagami **[0 points: incorrect suspect]**

Motive: **Something reasonable [+4 points]**

Evidence: **[2 points each]**

- Sugar - F&G
- Zinc - P
- Gelatin - I
- Sodium acetate - A
- Spandex - Fiber 3
- Fingerprint - Whorl, Loop

Chloe evidence

Evidence: **[1 point each]**

- Salt - I
- Vinegar - K
- Hydrogen Peroxide - L
- Lemon Juice - M
- Cat - Hair 2
- Blood Spatter
- LDPE - Plastic 3

- Alka Seltzer - J

Felix

Evidence: **[1 point each]**

- Yeast - C
- Baking soda - D&G
- Cornstarch - E
- Flour - J
- Water - N
- HDPE - Plastic 2
- Fingerprints: Tented Arch, Whorl
- RULE OUT - [1 POINT]

- Wool - Fiber 2
- Fingerprints
- Rule out - 1 point

Gabriel evidence

Evidence: **[1 point each]**

- Vitamin C - B
- Calcium Carbonate - H
- Cotton - Fiber 1
- Aluminum - Q
- Copper - O
- Calcium Sulfate - H
- PVC - Plastic 1
- Pen
- Fingerprints - Whorl, Loop
- Rule out - 1 point